

differs in the truncated and much split-up cardinal teeth and the broadly rounded posterior end of the shell. The *compressus* of Heude will therefore be called *Nodularia subpressa* Heude.

(To be continued.)

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THE DISCHARGE OF THE GLOCHIDIA IN THE UNIONIDÆ.

BY DR. A. E. ORTMANN.

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Only Lea has published a few facts which bear upon the question of how the glochidia of the *Unionidæ*, contained in the marsupium, are set free (Observ., II, x), but some of his observations are entirely wrong. Further, Simpson (Pr. U. S. Mus. 22, '00, p. 616) believes that the "ovisacs" (which I call now placentulæ) of the genus *Strophitus* are discharged through the walls of the gills, which again is wrong.

According to my observations the glochidia are discharged in the natural way in the following species: *Quadrula subrotunda* (Lea), *Quadrula undulata* (Barn.), *Pleurobema coccineum* (Conr.), *Pleurobema æsopus* (Green), *Strophitus edentulus* (Say), *Symphynota costata* (Raf.), *Anodontoïdes ferussacianus* (Lea), *Anodonta imbecillis* Say.

This natural way is: they go from the water-tubes (ovisacs), inside of which they develop, into the suprabranchial canal, from this into the cloacal chamber, and thence go out of the soft parts and the shell by way of the anal opening.

In *Quadrula subrotunda*, *Pleurobema coccineum* and *æsopus*, the whole placentæ are discharged. In *Strophitus edentulus* the whole placentulæ are discharged, but sometimes the glochidia become free already in the suprabranchial canal. In the other four species named the glochidia are rather loose when discharged, and are issued in the form of irregular masses, which do not stick together, so as to preserve the shape of the placentæ.

Entirely different from these shells, which belong to the two sub-families of the *Unionidæ* and *Anodontinæ*, is the discharge in the *Lampsilinæ*. Here the glochidia do not go out by the natural channels, but break through the walls of the gills, at the edge of the marsupium, by small holes formed for this purpose, which close again after the discharge. Each ovisac (water-tube) has one hole at its distal end, and the glochidia are generally discharged in irregular masses, rather loosely connected, without preserving the shape of the

placentæ. Only in one case, *Ptychobranchnus*, the placentæ are discharged whole.

Through these holes, of course, the glochidia are emptied into the branchial chamber, and from this they must go out through the branchial opening.

I have directly observed this discharge through the edge of the marsupium in the following species: *Ptychobranchnus phaseolus* (Hilbr.) (specimen preserved in alcohol in the act of discharging), *Lampsilis luteola* (Lam.), *Lumpsilis ventricosa* (Barn.), and *Lampsilis multiradiata* (Lea) (seen in life).

I have seen evidence of this discharge, in the shape of openings at the edge of the marsupium, in alcoholic material of *Lampsilis luteola* (Lam.), *Lampsilis multiradiata* (Lea), *Lampsilis nasutu* (Say), *Proptera alata* (Say), *P. gracilis* (Barn.), and *Obovaria circulus* (Lea).

It is very likely that the peculiar morphological structure of the marsupium of the *Lampsilinæ* is directly connected with and due to this "unnatural" discharge of the glochidia, and thus we would be able to correlate the chief morphological differentiation of the *Lampsilinæ* with a physiological differentiation. In the other two subfamilies, *Unionidæ* and *Anodontinæ*, the primitive and natural way of discharge has been preserved.

But also between these latter two subfamilies we have morphological differences which are connected with physiological differentiation: the *Unionidæ* possess the more primitive structure of the marsupium, and they are all "summer breeders," or, to express the characteristic feature, are forms with a short breeding season. The glochidia are here discharged as soon as they are fully developed. In the *Anodontinæ* we observe highly complex structures of the marsupium, which apparently are correlated with the fact that they are "winter breeders," or forms with a long breeding season. Here the glochidia, after being fully developed, are not immediately discharged, but are carried through the winter, and for this purpose special structures are present which serve for the proper aeration of the marsupium during this period.

I publish these observations and conclusions chiefly with a view to induce others to test them by looking for additional cases in other species and genera.

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#### NOTES ON CALIFORNIA SHELLS.

BY W. H. DALL.

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During the past summer I visited the Pacific coast with the object of gathering data on the tertiary and recent mollusk faunas of the